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**Title:** Imbibition assisted oil recovery**Authors:** Pashayev, Orkhan H  
Maggard, Bryan J.  
Ahr, Wayne M.  
Schechter, David S.**Keywords:** Capillary imbibition**Issue Date:** 15-Nov-2004**Publisher:** Texas A&M University

**Abstract:** Imbibition describes the rate of mass transfer between the rock and the fractures. Therefore, understanding the imbibition process and the key parameters that control the imbibition process is crucial. Capillary imbibition experiments usually take a long time, especially when we need to vary some parameters to investigate their effects. Therefore, this research presented the numerical studies with the matrix block surrounded by the wetting phase for better understanding the characteristic of spontaneous imbibition, and also evaluated dimensionless time for validating the scheme of upscaling laboratory imbibition experiments to field dimensions. Numerous parametric studies have been performed within the scope of this research. The results were analyzed in detail to investigate oil recovery during spontaneous imbibition with

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different types of boundary conditions. The results of these studies have been upscaled to the field dimensions. The validity of the new definition of characteristi...

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**imbibition****1. n. [Formation Evaluation]**

The process of absorbing a wetting phase into a porous rock. Imbibition is important in a wa reservoir because it can advance or hinder water movement, affecting areal sweep. Spontai imbibition refers to the process of absorption with no pressure driving the phase into the roc

It is possible for the same rock to imbibe both water and oil, with water imbibing at low in-sit saturation, displacing excess oil from the surface of the rock grains, and oil imbibing at low i saturation, displacing excess water. An imbibition test is a comparison of the imbibition pote and oil into a rock. The wettability of the rock is determined by which phase imbibes more.

See: drainage, oil-wet, water-wet, wettability



# imbibition

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**im·bi·bi·tion** (im'bĕ-bĭsh'ən)

*n.*

1. The act of imbibing.
2. *Chemistry* Absorption of fluid by a solid or colloid that results in swelling.

**im'bi-bi'tion-al** *adj.*

The American Heritage® Dictionary of the English Language, Fourth Edition copyright ©2000 by Houghton Mifflin Company. Updated in 2003. Published by Houghton Mifflin Company. All rights reserved.

**Noun 1. imbibition** - (chemistry) the absorption of a liquid by a solid or gel

**chemical science, chemistry** - the science of matter; the branch of the natural sciences dealing with the composition of substances and their properties and reactions

**absorption, soaking up** - (chemistry) a process in which one substance permeates another; a fluid permeates or is dissolved by a liquid or solid

**2. imbibition** - the act of consuming liquids

**drinking, imbibing**

**consumption, ingestion, intake, uptake** - the process of taking food into the body through the mouth (as by eating)

**guzzling, swilling, gulping** - the drinking of large mouthfuls rapidly

**potation** - the act of drinking (especially an alcoholic drink)

**Legend:** [Synonyms](#) [Related Words](#) [Antonyms](#)

## Some words with "imbibition" in the definition:

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<a href="#">Bibulously</a>	<a href="#">guzzling</a>	<a href="#">potation</a>	
<a href="#">consumption</a>	<a href="#">imbibing</a>	<a href="#">soaking up</a>	
<a href="#">drinking</a>	<a href="#">ingestion</a>	<a href="#">swilling</a>	

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• <a href="#">imbauba</a>	• <a href="#">Imbenching</a>	• <a href="#">Imbitterment</a>	• <a href="#">Imbolden</a>

# *Synthesized Mesophase Pitch*



The ideal raw material for high  
performance carbon products

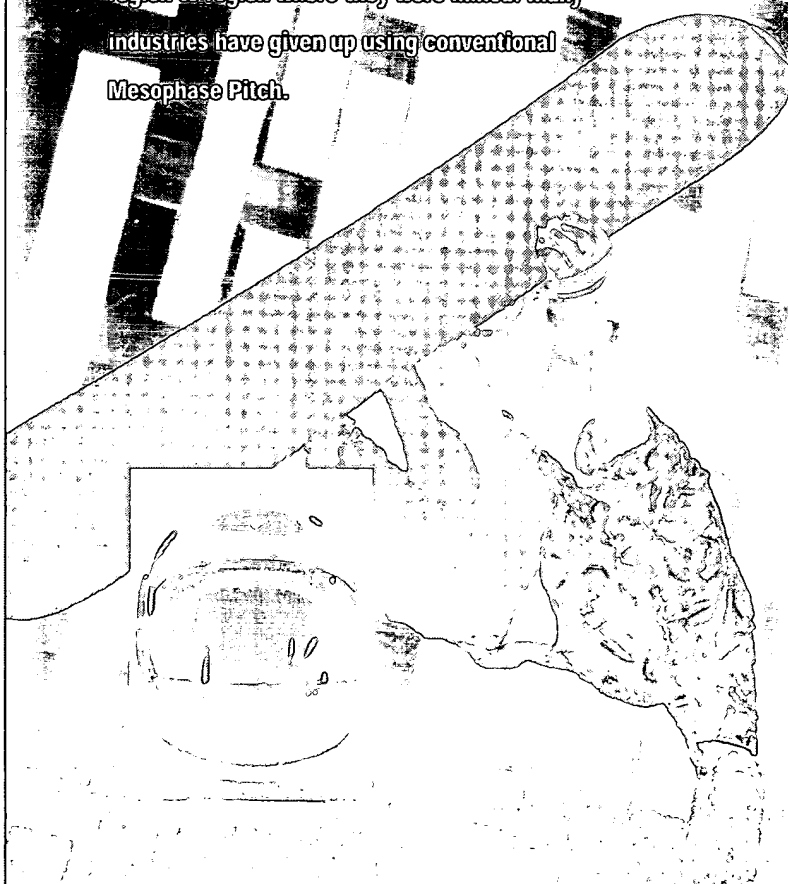


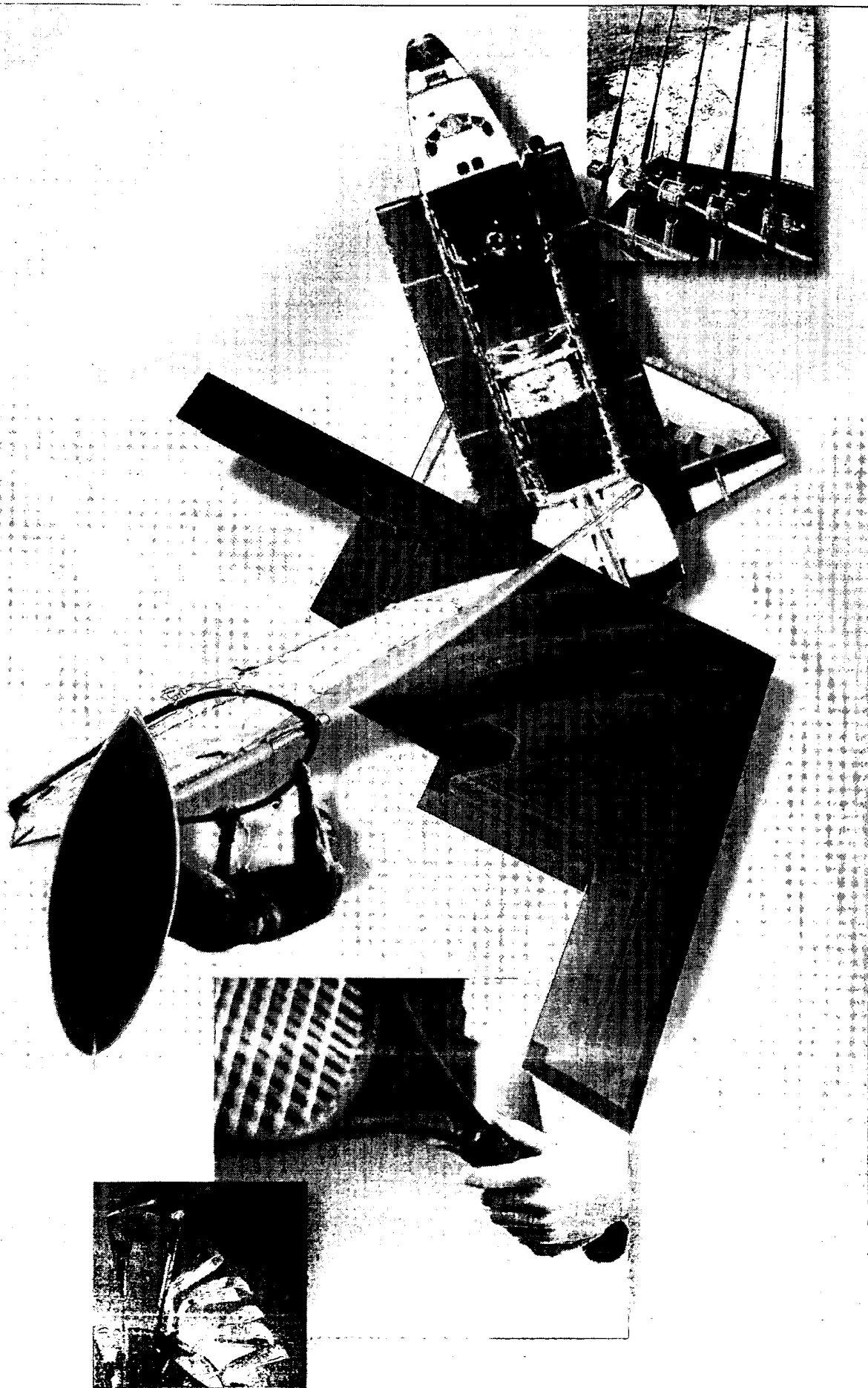
**MITSUBISHI GAS CHEMICAL COMPANY, INC.**

# From Conventional to Unique:

Carbon products, like carbon fibers or G/C composites, are gaining lots of attention these days. The products can save weight and, consequently, save energy. Aircraft, space vehicles and sporting goods use many carbon parts. Besides being lightweight, carbon products offer outstanding performance, both physically and chemically.

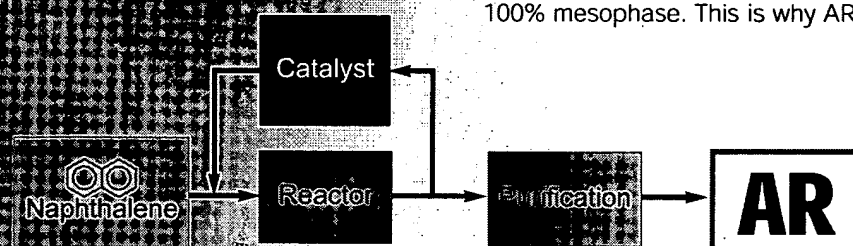
Pitch is in the spotlight as one of the key raw materials. Mesophase Pitch, meaning liquid crystal state pitch, is considered the most important feedstock for higher performance carbon products. Yet conventional Mesophase Pitch is difficult to use commercially because of its unavailability and inconsistent quality. It is very difficult to manufacture the material in consistent quality from petroleum residue or coal tar because their components and impurities vary from region to region where they were mined. Many industries have given up using conventional Mesophase Pitch.



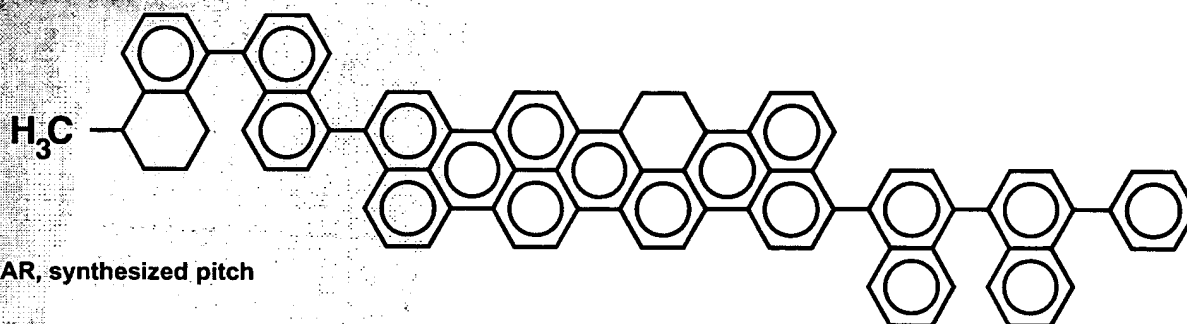


# Synthetic AR Changes the Way You Look at Mesophase Pitch

Mitsubishi Gas Chemical Company has overcome these barriers by employing a special synthesis technology. This technology is a polymerization of naphthalene and/or alkyl-naphthalene using a super acid catalyst. Because the monomer is the starting feedstock, the quality of the final product is consistent. Surprisingly, synthetic AR shows a very low softening point and low viscosity at a molten stage while retaining a high coking value and, of course, 100% mesophase. This is why AR is the unique mesophase pitch.

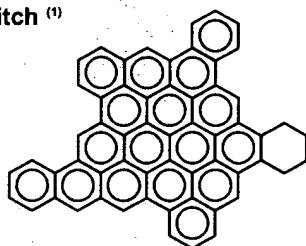


Manufacturing Process of AR

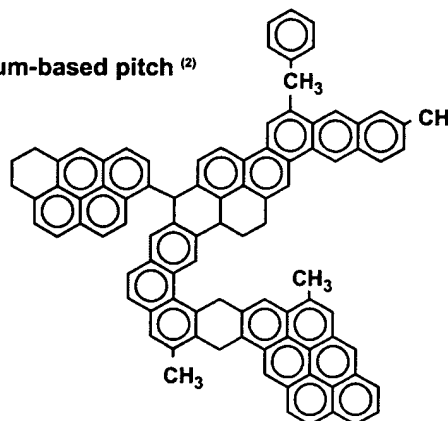


AR, synthesized pitch

Coal tar-based pitch <sup>(1)</sup>



Petroleum-based pitch <sup>(2)</sup>



Model Structures of Various Mesophase Pitches

1) T. Nishizawa, *Journal of the Japan Institute of Energy*, 1992, 71, 801.

2) E. Fitzer, D. Komplik and B. Mayer, *Carbon '86, Proceedings of International Conference on Carbon*, Baden-Baden, 1986, 842.



# Applications

When using the mesophase pitch as the matrix of the Carbon-Carbon composite (C/C composite), the viscosity of the mesophase is a very important factor. If the viscosity is too high, the mesophase pitch does not impregnate well into carbon fiber preform. Dr. J. L. White, UCSD, proposed the viscosity formula of mesophase pitches to achieve good C/C composites.\* The viscosity curve of AR, which is shown in Figure 1, is right through the processing window in Figure 2. AR seems to be an exceptional mesophase pitch to the matrix of the C/C composite.

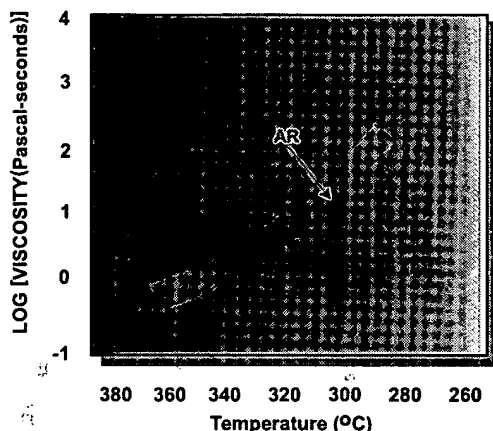


Figure 1 - Viscosity as a function of temperature

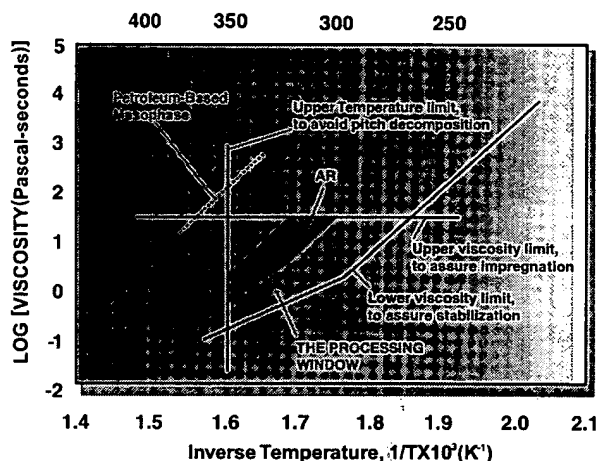
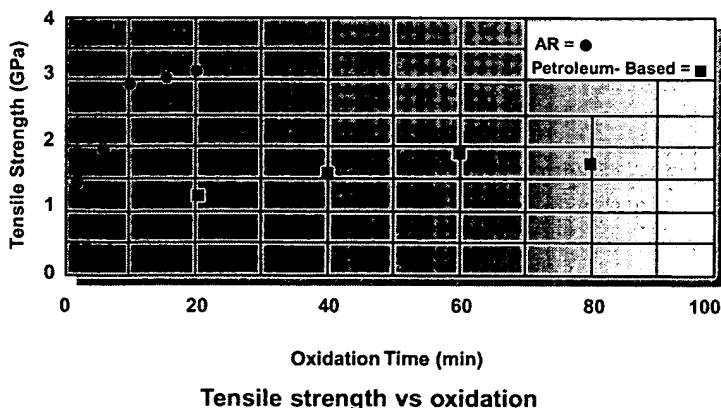


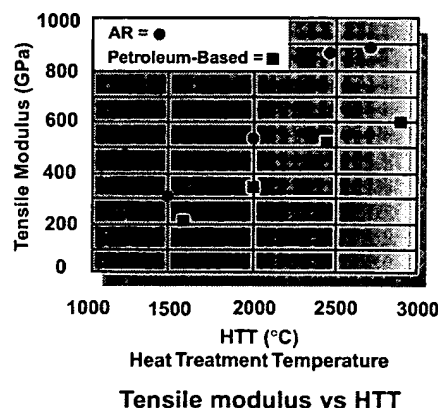
Figure 2 - The evaluation of AR by the processing window

# Carbon Fibers Advantages

There are many advantages to using AR as a raw material of carbon/graphite fibers. The high reactivity with oxygen can shorten the stabilization process dramatically. The physical properties of the carbon/graphite fiber from AR are far superior to those from conventional mesophase pitches. Additionally, the carbon fibers from AR show an exceptional high thermal conductivity.



Tensile strength vs oxidation



Tensile modulus vs HTT

\*J. L. White and M.K. Gopalakrishnan, *Extended Abstracts of 20th Biennial Conference on Carbon*, 1991, 184.

Table 1 - TYPICAL PROPERTIES OF AR

Physical Properties	
Appearance	Black Pellet (3mm*7mmL)
Bulk Density (g/cm <sup>3</sup> )	>0.65
Specific Gravity (25°C)	1.23
Specific Heat (cal/g°C)	0.65
Softening Point (°C) by Mettler	275
Mesophase Content (%)	100
Hydrogen/Carbon (atom/atom)	0.58-0.64
Flash Point (°C)	>300
Ash (ppm)	<20
Solubility (%)	
Water Soluble	0
Benzene Soluble	35-44
Pyridine Insoluble	40-50
Coking Value (%) at 1hr, 600°C	
1 atm	80-85
30 atm	90-95
TSCA registry CAS No.	25135-16-4

Table 2 - TOXICOLOGICAL INFORMATION

Acute Oral LD50 (rat)	>5,000 mg/kg
Skin Irritation	Slightly Irritating
Mutagenicity (Salmonella)	negative
Mutagenicity (E. coli)	negative

Table 3 - FEATURES OF AR GRADES

Grade	Features	Typical Applications
HP	Lower Volatile	Continuous Graphite Fiber
MP	Standard	Melt Blown Carbon Fiber C/C Composite Matrix Binder

## PACKING

Supersack	NET 500kg
Fiber Drum	NET 100kg
Pail Can	NET 20kg

AR is a unique new material, with additional data forthcoming. Our technical staff is continuing to explore the features offered by AR at Mitsubishi Gas Chemical's Central Research Laboratory. New findings will be reported in the near future.



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